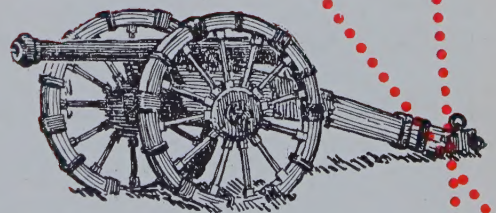
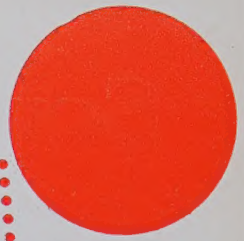


# GRAPHIC SCIENCE



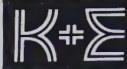
AUGUST 1960

*Drawings for the Military*  
MIL-D-70327

UNIV OF ILLINOIS  
2078 TRANSPORT'N BLDG  
URBANA ILL  
ATT GRACE WILSON-ASST  
CD-VS-2  
PROF



# Some Ideas



for your file of practical information on  
drafting and reproduction... from

**KEUFFEL & ESSER CO.**

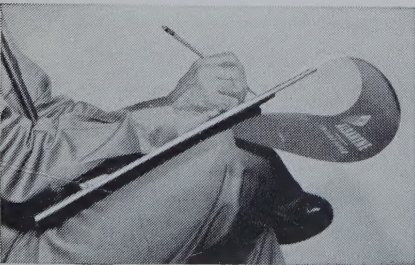
Papers, in their special way, are as different as people... and choosing the best paper for a specific job can be as difficult as choosing the best *person* for the job. Here at K&E, we try to do the work for you, by painstakingly determining precisely the characteristics required, then refining them to the point of excellence. Here are some good examples:

## A New Type Of Typing Paper

Translucent typewriter papers are very popular of late for typed originals from which numerous copies must be made. The savings are considerable when you use translucent originals through diazo reproduction—savings up to 80% in many cases. But most translucent papers used today stand erasure very poorly. Recognizing the inevitability of human error, K&E has perfected a better translucent typewriter paper called **TPEMASTER® (193)**—the perfect answer for those whose typing is less than perfect. **TPEMASTER's** completely new, *engineered* surface affords outstanding erasability. A thin, unusually tough coating, it readily catches and holds the typewritten image, yet resists penetration of the ink into the paper fibers... and therein lies the secret of good erasability. A number of skeptics who tested the new **TPEMASTER** sheets have now discarded all others. Skeptical or not—may we suggest you try it.

## Tracing Pads "To Travel"

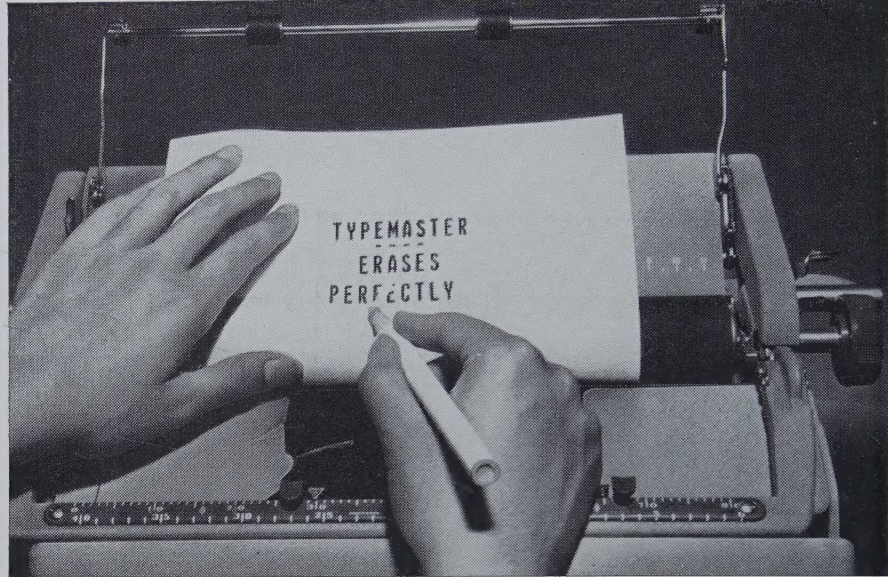
Brilliant ideas often occur at random moments. For that reason, engineers on the move usually keep a tracing pad handy. But pads with soft, chipboard backing are of little use without a desk under them. That's why all K&E tracing pads are backed with sturdy bookbinder's board—the same tough board found in any high-



priced, permanently-bound library volume. Wherever you are you're assured desk-firm support with a K&E pad. Another plus—the sheets are bound in by a gummed edge for neat and easy removal. Available in a wide variety of grid patterns and sizes, with plain or imprinted sheets (standard headings), K&E book-bound, gummed-edge tracing pads are perfect workmates for the "portable" professional.

## The Most Pampered Natural Paper In America

For the greatest transparency, the overwhelming choice is K&E **ALBANENE®** prepared tracing paper. But for ability to

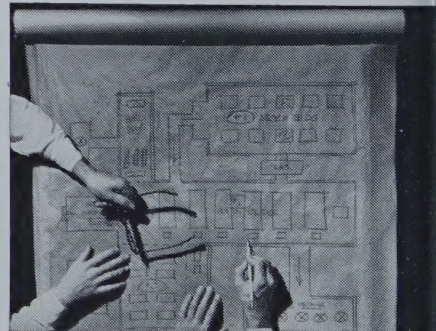


stand a lot of abuse on the drawing board and in subsequent processing and handling—many companies prefer to sacrifice some transparency and use a *natural* tracing paper. Here we recommend a truly remarkable K&E product—**BANKNOTE T.M. (174L)**. This thin, flexible, 100% rag tracing paper will weather a double share of abuse. You can actually crumple a sheet of K&E **BANKNOTE** up into a tight ball... then smooth it out to find it almost as good as new for reproduction purposes! The paper makers who produce **BANKNOTE** for K&E proudly refer to it as America's most pampered tracing paper. No other paper we know receives the same care and attention... from initial inspection of the textile bales, through every step of processing, to final shipment. With K&E **BANKNOTE**, papermaking skills come into play as with no other paper made on this side of the Atlantic—from use of a paper machine that runs a "top jacket" (one of the few still employed), through the artful "wet packing" process, to careful air-drying, super calendering, and rewinding. The result is a sheet of unsurpassed mellowness, yet with unusual stamina and workability.

## Now You Can "Talk" In Triplicate

Although low-priced canary tissue enjoys wide usage as a so-called "talking paper", we've heard many complaints about its

inability to reproduce well in standard copying machines. With this in mind, we present K&E's newest **LIGHTWEIGHT SKETCHING TISSUE (185)**—designed specifically as a *reproducible* "talking paper." This tissue is ideal for preliminary sketching when you want sharp reproductions from a standard diazo, blueprint or office copying machines. It's a pure bleached sulphate with just enough yellow tint added to afford good contrast for pen-



cil, charcoal or crayon. You'll find K&E **LIGHTWEIGHT SKETCHING TISSUE** well worth any small price difference.

You can test this quartet of fine papers at your local K&E dealer's... or use the coupon below to get samples for private perusal. Do it *today*... there's a world of better work at stake.

**KEUFFEL & ESSER CO., Dept. GS-8, Hoboken, N. J.**

Please send me samples and further information on the following:

- ☐ K&E **TPEMASTER** Translucent Typewriter Paper
- ☐ K&E **BANKNOTE** Tracing Paper
- ☐ K&E **LIGHTWEIGHT SKETCHING TISSUE**

Name & Title \_\_\_\_\_

Company & Address \_\_\_\_\_



# GRAPHIC SCIENCE

THIS ISSUE: 11,500 COPIES

AUGUST 1960

VOLUME 2 NUMBER 8

The Magazine of engineering drawing management, covering drafting, reproduction and microfilming, technical illustration, drawing standards and drawing filing in all industries.

## SPECIAL ISSUE: DRAWINGS FOR THE MILITARY

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*Drafting department managers, financial and accounting department heads and top management—all will feel the impact of this new Specification*

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### DEPARTMENTS

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# Letters

## More Readers

Sirs:

I have been receiving your magazine since October 1959 and I find it very interesting and helpful. I have purchased a number of the products advertised in the magazine and as a result improved the effectiveness of my operation.

Also the draftsman reporting to me anxiously await each issue, they too are interested in new products and techniques.

At a recent meeting of the Drafting Supervisors' Association I was surprised to learn that you did not have complete coverage of the General Electric Company here in Schenectady.

Because I feel it would be to your advantage as well as ours I have sent a Subscription Application Form to each member of our organization who is not currently receiving your magazine. I hope you may view these applications favorably.

J. A. CHOULES  
President

Drafting Supervisors' Association  
General Electric Co. Schdy, N. Y.

## Microfilming Articles

Sirs:

The enclosed complimentary subscription application was received by our chief engineer, Mr. Dave Youngquist, who turned the copy over to me. Accordingly, I have filled it out to continue to receive your publication.

I have been wondering if there was a publication of this type. In the past I read articles appearing in *Design News*, *Electrical Design*, etc., and although interesting, they did not fit the needs of the drafting supervisor. Your articles on microfilming are especially interesting to us because we are just starting a microfilming system here. Thank you for your copies of *GRAPHIC SCIENCE*. May I take this opportunity to wish you continued success in 1960.

DONALD C. HANSON

Chief Draftsman  
The Potter Company  
1950 Sheridan Road  
North Chicago, Illinois

## Teachers of Teachers

Sirs:

It is the purpose of this letter to suggest another significant category of readers qualified to receive *GRAPHIC SCIENCE* free. Throughout many colleges and universities (approximately 200) there exist competent teacher educators who prepare industrial arts teachers. One of the major functions of such persons is to instruct future teachers of drawing and drafting, who will in turn instruct young students in the secondary schools in drafting. It is extremely difficult for both mentioned groups of teachers to keep up with new methods and techniques, equipment, and supplies in drafting.

Your publication would prove to be a significant contribution in the education of future secondary school drafting instructors.

In many larger institutions, such as Ohio State, Illinois, Purdue, Minnesota, and others, instruction for prospective industrial arts teachers in drafting is given by the engineering drawing or graphics department. (Here at Ohio State we share this responsibility.)

In addition, the area of graphic reproduction is a significant portion of industrial arts education. Teacher educators of the graphic arts (photo-offset portion) would profit from the articles and advertisements in *GRAPHIC SCIENCE*.

Would it not be equally important to provide copies of your journal to college instructors in drafting and graphic arts (for industrial arts teacher preparation) since they render a significant service to the total picture of preparation of draftsmen, illustrators, and engineers?

WILLIS E. RAY  
Assistant Professor of Education  
Industrial Arts Teacher Education  
The Ohio State University  
Columbus 10, Ohio

*Editor's Note: We agree on the importance of keeping teachers of drafting informed of latest drafting developments. We are happy to forward applications for free subscriptions to all those in teacher education interested in this field.*

## Articles Wanted

Sirs:

Just received my first copy of your excellent magazine and would like to express my appreciation for being included in your mailing list.

In the June issue, under "Letters", Arthur E. Jaskower submitted a list of subjects he would like to see discussed.

I heartily agree and would like to add a few more:

"Detail - Assembly Drawings vs. Individual Detail Drawings."

"Specifying Finish on Parts to be Spotwelded."

"Installation Information Drawings."

"Dimensioning from Centerline vs. Dimensioning from Datum Line vs. Dimensioning from Edges."

"Standardized Head Dimensions and Threads per inch, on #00, #000 and #0000 Screws."

I am sure many of your readers would be happy to contribute data based on their experiences with these subjects.

ROBERT W. BOYD

Chief Checker  
Laboratory for Electronics, Inc.  
75 Pitts Street  
Boston 14, Massachusetts

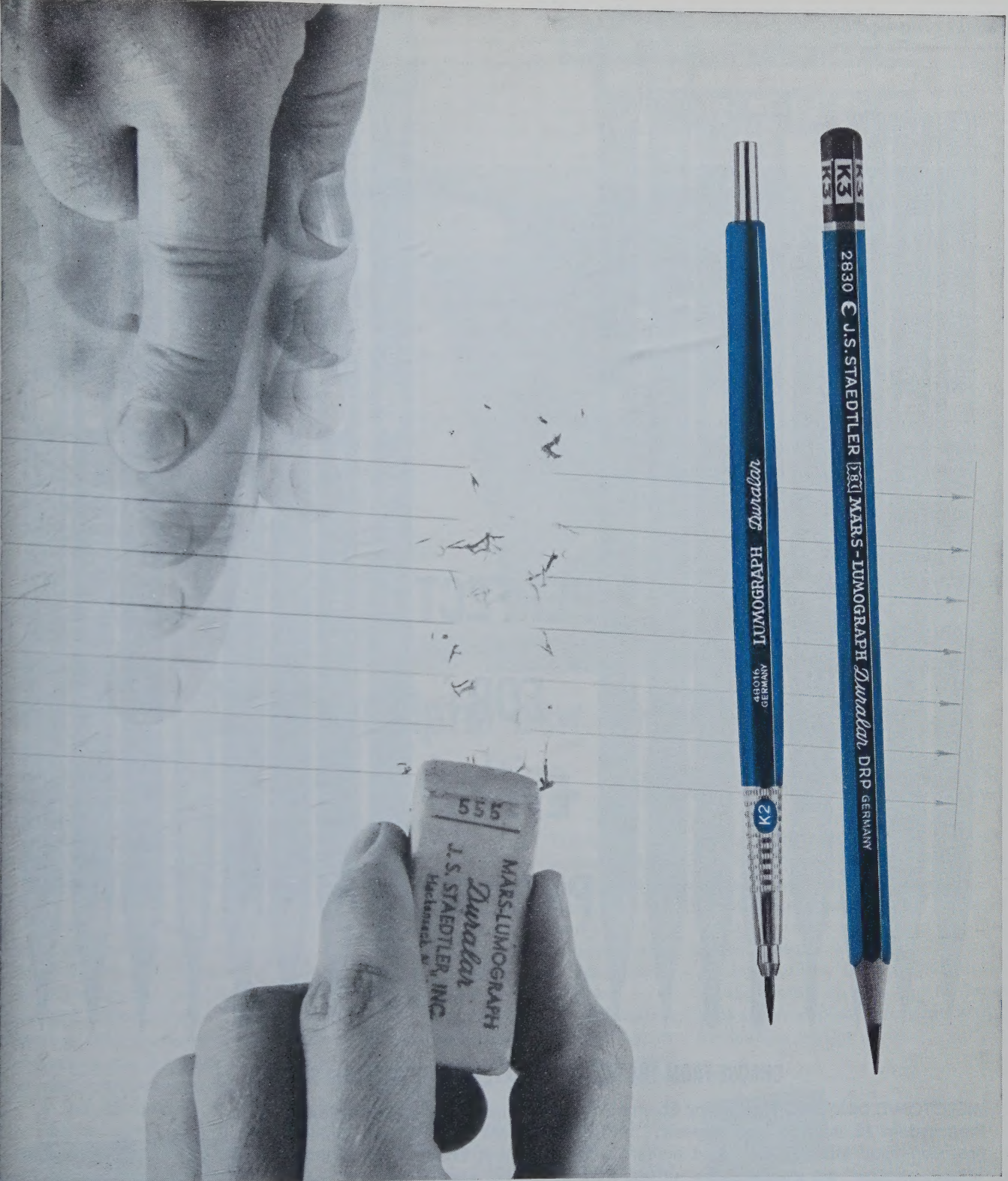
## Coverage

Sirs:

Your magazine has just recently come to my attention. From what I have seen, you are certainly to be congratulated on the coverage to date. I am particularly impressed by the articles on "Engineering and Drafting Supervisors" by George C. Schmidt, the future role of draftsmen and, the tremendous advances possible through systemization of information and processing the information through microfilming, punch cards, tape, etc. Up-to-date reporting on the state of the art is always in demand.

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# Letters

(Continued)

## True Position Dimensioning

Sirs:

We were pleased to find a story about our book "True Position Dimensioning" appearing in the Bookshelf Section of the May 1960 issue of GRAPHIC SCIENCE.

As a complement to the book we have developed a Tolerance Converter with which it is very easy to determine if the horizontal and vertical readings resulting from open set-up inspection reflect a hypotenuse which is within the "True Position Tolerance" specified on a drawing. This Converter can also be used to solve any right triangle having two known sides.

It occurs to us that you might wish to also mention this item in your magazine, and we enclose a sample for your examination. It is available from the Publications Department of Scintilla Division, The Bendix Corporation, Sidney, New York at a price of \$1.25 each.

F. O. RETTBERG

Advertising Manager  
Scintilla Division  
Bendix Aviation Corporation  
Sidney, New York, U. S. A.

## Electronic Equipment Drawing Time

Sirs:

Reviewing letters to the editor column in your June issue, page 4, a Mr. J. P. Pelamate, Director of Project Engineering Service, Librascope, requested information on "What is the average time for drafting preparation of various size drawings of electronic or electromechanical equipment?"

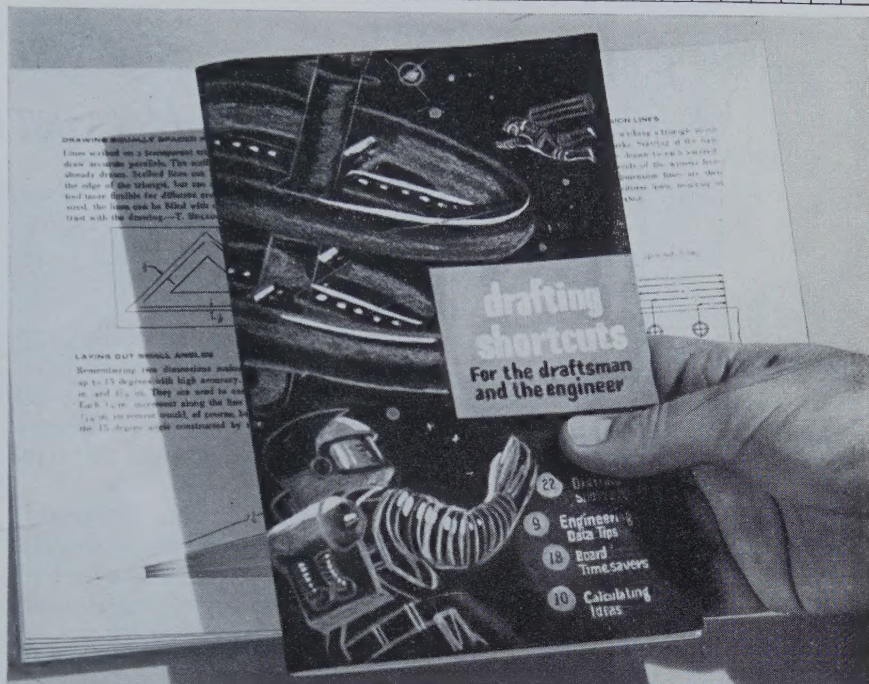
If this information is available, it would be appreciated if you would forward it to me at the same time. Also, would you have pertinent information on "What is the average time required to complete a format and design check of the above-mentioned drawings (percent of checking time vs. drawing or documentation time.)?"

I look forward to hearing your comments.

R. J. WORSWICK

Project Engineer  
The Martin Company  
Mail No. MP-241

# DRAFTING TRENDS



## Helpful new booklet suggests drafting, engineering shortcuts

Just published—"DRAFTING SHORTCUTS" is a completely new booklet of helpful ideas and aids for engineers, draftsmen and students. It is well illustrated, clearly and logically written. It contains a wealth of time-saving tips to speed both routine and specialized tasks.

The ideas selected were submitted by professionals and judged by an impartial panel of widely recognized authorities on the various topics covered.

As an example, the section covering *Calculating Ideas* includes a simple means of locating stress points on cantilevered beams, also a simple method for retaining fundamental trigonometric relations.

In the section on *Drafting Shortcuts*, our editors have come up with topics like a simplified, fast and easy method for drawing gear teeth profiles and a rapid means of showing twisted wire elements.

The *Engineering Data* section covers new, easy-to-use shortcuts to formulas and engineering data.

There's a special section devoted to time-saving techniques on the drawing board, too. One of the suggestions on how to make life easier for the draftsman tells how to use a bent paper clip as a variable guide for making section lines.



For your free copy of "Drafting Shortcuts" contact your POST dealer or write today to the Frederick Post Company, 3656 N. Avondale Avenue, Chicago 18, Illinois.



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## Graphic Perspective

Our second guest-written "Perspective" recounts the history of pencil-making beginning with Part I below. Part II will appear in the September issue.—Ed.

by William E. Danjczek\*

THE PENCIL industry traces its birth to the uprooting of a large oak tree during a storm, and the subsequent discovery of the famous graphite mine of Borrowdale, England. This was in 1565, during the reign of Queen Elizabeth. A mountaineer who noticed the particles of a strange black substance clinging to the roots of the fallen tree spread the news to the countryside of a "mysterious mineral."

In time, news of the discovery went abroad. Interest was aroused and many theories were advanced as to the nature of the material. It was called "wad" and "black lead." Graphite (from the Greek *graphein*, to write), the name finally adopted, was not bestowed upon it until two centuries later.

Perhaps it is not strange that the first use this new mineral was put to was in branding the sheep of the neighborhood flocks.

This wonder-stirring black mineral was invested by the superstitious countryfolk with curative properties effective in many ailments. In this enlightened day it is easy to laugh, but at that time, the curative virtue of graphite was firmly believed by the unlettered people of that section. Even doctors prescribed it, and apo-

thecaries kept it on their shelves with other medicines. In using it "they first beat it up to a fine meal and took as much as would cover a sixpence." There is no record of cures that were traced to it.

The fame of the Borrowdale graphite was due to its remarkable purity. Nothing like it had ever been known, nor has any of equal quality been found since.

The nature of the deposits made it possible to remove large slabs of pure graphite which, after first being sawed into thin sheets, were then glued in wood for protection in use.

This mine gave England a monopoly on pencil manufacturing for many years. Pencils became known on the Continent as *Crayons D'Angleterre*. Export of the graphite in the shape of lead pencils was prohibited and, to prevent over-production, only a limited quantity of graphite was mined. If six-weeks' working would provide the pencil makers with a year's supply, the mine was closed down for the rest of the year. Later, when the pencil industry lagged, the mine was opened only at long intervals—once in five or six years.

Value of the graphite was high—36 to 40 shillings a pound—and at times probably much higher. Since the mine was in a remote mountainous district, inroads from robber bands were not infrequent. It is said that many of the villagers subsisted chiefly by stealing or trafficking in stolen black lead. Some became rich.

An act of Parliament during the reign of George II declared it a felony to break into any mine. This was not so much a protection for the owners as it was to insure a supply for the casting of bomb shells and cannon

balls for His Majesty's forces.

A market for graphite was established in London where it was sold at auction on the first Monday of each month.

In 1710 the mine was reopened for the first time since 1678, when it had been considered worked out. It was discovered that pilferers had been busy carrying on the old workings until the lode was lost in the rock. Not long afterward, a new lode was discovered "which proved so rich that in less than 24 hours, the workmen had filled several sacks with fine, clean-washed mineral."

In 1791, after several unsuccessful years, the mine produced about five tons, but the quality was inferior.

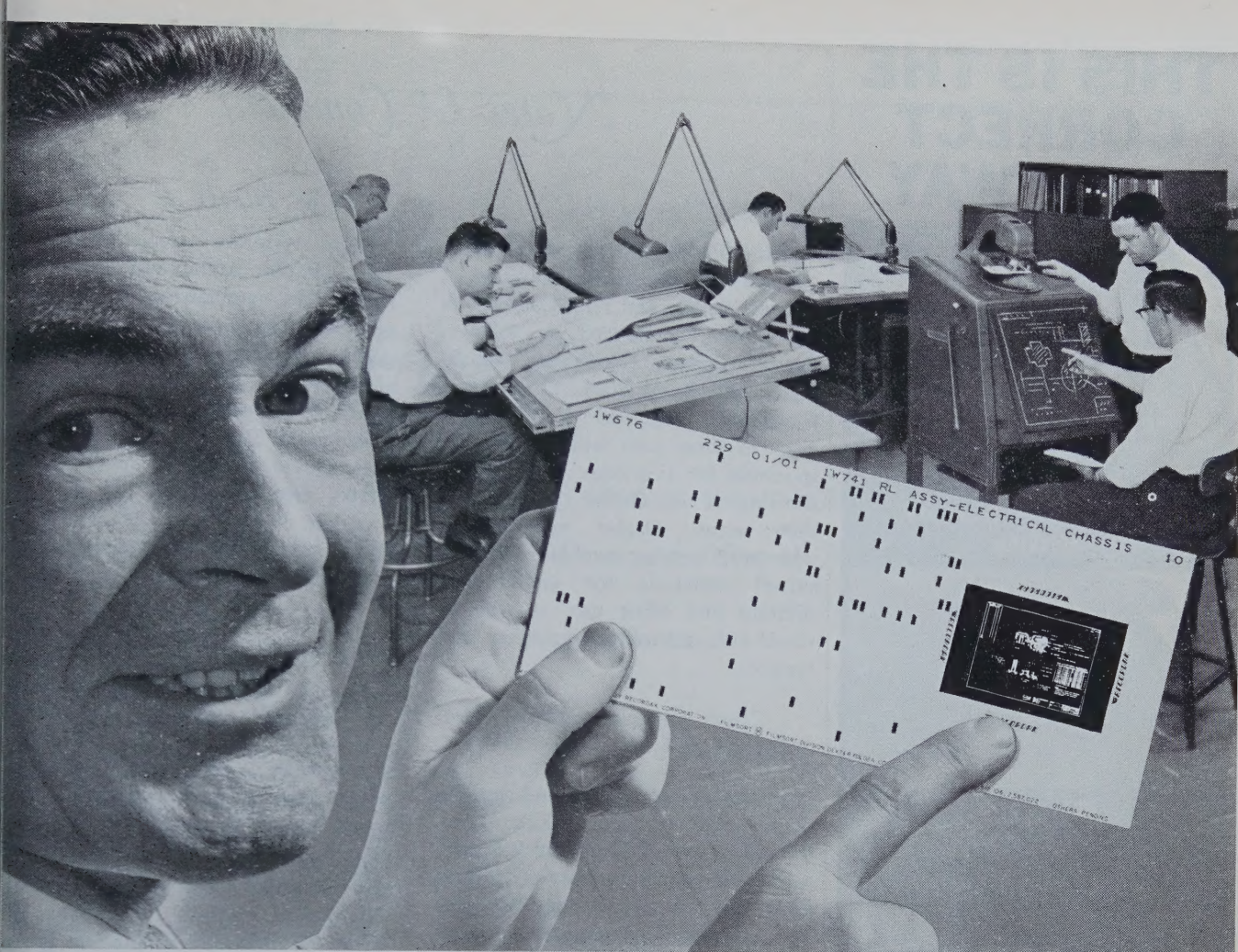
The gradual working out of the Borrowdale mine had caused pencil makers in England and on the Continent to seek an effective method for using graphite in powdered form. There was a large accumulation of this in the English mine, while the Bohemian and other mines which had since been opened, did not produce graphite in a form which would permit its use except when pulverized. The search was taken on for a binder. Glue, sulphur, and other compounds were used with indifferent results.

In 1790 a process was perfected which solved the problem. It was an invention shared by Nicholas Jacques Conte, a French mechanic, and Josef Hardtmuth of Vienna, who—in this same year—founded the house of L. & C. Hardtmuth. The Hardtmuth-Conte process marked the beginning of a new era in the industry. The Hardtmuth factory and other factories in France immediately adopted the new method of lead-making.

(To be continued)

\*William E. Danjczek is president of Koh-I-Noor Pencil Co., Inc., Bloomsbury, N.J., founded by the house of L & C Hardtmuth.





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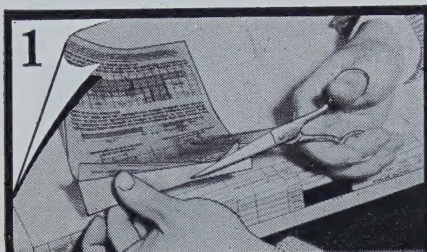
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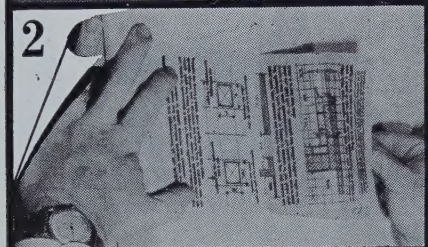
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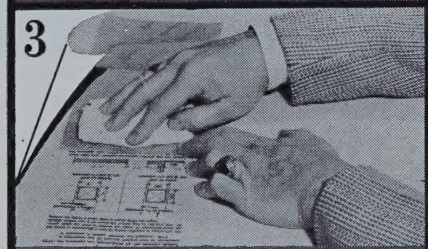
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## Notes & Comment

### Branch Managers

**T**HREE NEW BRANCH sales managers for the Ozalid Division of General Aniline and Film Corporation have been announced as follows: Detroit, Ludwig J. Schomig; Washington, D. C., William A. Boetker; Cincinnati, Raymond V. Hawkey. Each of these men will be fully responsible for the sales, service, and distribution of Ozalid products in their areas. Ozalid manufactures whiteprint copying machines and sensitized materials for engineering, drafting and office use, as well as visual aids, microfilm equipment and supplies.

### Subsidiary

**P**HOTOCOPY equipment and supplies manufacturer General Photo Products Company of New Jersey is now a wholly-owned subsidiary of Cormac Photocopy Corp., 80 Fifth Ave., New York 11, N. Y. According to a recent announcement by Botho Lilienthal, Cormac's Board Chairman, his company also obtains the dry photocopy process (Electrofax) development, which General Photo had developed to prototype stages under license agreements with R.C.A. and Haloid Xerox Corporations. It is Cormac's intention to accelerate development work.

### Pioneer

**T**HE NATIONAL MICROFILM ASSOCIATION honored John K. Boeing, chairman of the board of Recordak Corp., with its Annual Award of Merit at the NMA annual banquet at the Statler-Hilton Hotel, April 19, 1960. Citing Mr. Boeing as "one of the pioneers of microfilming," NMA award chairman Robert A. Boylan stated that the award was made for "distinguished service to the microfilm industry." He noted that when Mr. Boeing first joined Recordak in 1928, after eight years with Eastman Kodak Company (Recordak's parent organization), the entire staff consisted of eight men.

### NAPM Elects

**T**HE NATIONAL Association of Photographic Manufacturers, Inc., nationwide membership organization of concerns manufacturing photographic products of all kinds, has elected four new members to its Board of Directors: Selah Brewster, president of Peerless Photo Products, Inc., David Goldstein, president of Elgeet Optical Co., L. S. Kubiak, president of Photogenic Machine Co. and Gerald B. Zornow, vice-president of Eastman Kodak Co.

### Microreproduction "Bible"

**T**HIRD PRINTING of the *Guide to Microreproduction Equipment* is now off the press, and according to *The National Micro-News*, it is unlikely that further reprints will be made. First published in April 1958, the original edition, as well as a second printing, were soon exhausted. The *Guide*, edited by Hubbard W. Ballou, is intended to provide accurate information (including prices) on all known microreproduction equipment made or sold in the U. S. It contains 438 pages and over 200 illustrations. Continuation entries to keep the *Guide* up-to-date appear in the *National Micro-News*, bimonthly publication of the NMA. Copies are available at \$7.50 each, postpaid, with remittance accompanies order, otherwise \$8.00 to cover costs of shipping and billing. Price to NMA member is \$5.00 postpaid. Send orders, accompanied by remittance, to the National Microfilm Association, P.O. Box 386, Annapolis, Maryland.

### Idea Generator

**M**ORE THAN 150 inventions were displayed at the Cleveland Engineering and Scientific Center on June 20-24. Called the National Inventions Exhibition and Creativity Conference, the program is sponsored by the Cleveland Engineering Society. Aim of the Conference is to promote invention, research, and business by bringing inventors and investors together.



# Drafting for the Military

*One representative of industry sees added expense  
and confusion resulting from adoption of MIL-D-70327*

by Rowen Glie

Elsewhere in this issue, W. W. Thomas of R.C.A. gives his analysis of MIL-D-70327. Also in this issue, is a case history of the experience of the Bureau of Ships when they automated their drawings' file (in an evaluative program antedating MIL-D-70327).

THE MILITARY Services spend annually, one-and-one-half billion dollars for drafting and one-half-billion dollars for reproduction of drawings. Thus, a modest cost increase of 10 per cent means \$200-million more for military drafting. Some predict that drafting costs will increase as much as 200 to 300 per cent. Although this evaluation seems to be somewhat exaggerated, one may well ask, "Why are these increases inevitable?"

Well, in the near future, drawings supplied to the Government will not be original tracings, but microfilmed copies. With the advent of microfilm, we can forget the free-hand sketches of the "simplified drafting" era. For microfilming, drawings must be very carefully prepared, lines must be of uniform thickness, notes carefully printed and widely spread, and erasures must be held to a minimum. The use of expensive intermediate prints will be increased, and we will have to select drawing paper one size larger than that which we now use. The necessity of producing drawings of a quality sufficient to permit microfilming will, in itself, increase drafting

time, and hence drafting costs.

Adherence to the new Specification, MIL-D-70327, is bound to be an expensive proposition in other ways as well. For instance, MIL-D-5028 *Drawing and Data Lists*, calls for compliance to 14 military standards; MIL-D-70327 calls for compliance to 25 military standards—more than 500 pages of rules and regulations. And compliance to these standards will be rigidly enforced in accordance with paragraph 4.2 of MIL-D-70327, which states:

"Review and checking. The design activity responsible for the preparation of the drawings and associated lists shall review and check the drawings, lists, and referenced documents for completeness, technical and engineering accuracy, legibility, reproducibility, and for conformance to the requirements specified in the contract prior to the submission of this data to the procuring activity."

This means additional personnel for quality assurance provision, more effort per draftsman, and more draftsmen.

MIL-D-70327 was supposed to supersede 150 drafting documents, and for this idea alone, I would like to say, "God bless you, Department of Defense!" But, when I looked at the specification for the first time, didn't I find in MIL-D-70327, the enumeration of the 150 specifications it was supposed to supersede!

What does it actually supersede? Does it supersede MIL-D-5028? It should, but the newest Air Force Index (dated April 1959 and issued January 1960) does not even mention MIL-D-70327; it does mention MIL-D-5028.

The confusion as to what it does supersede spreads to such documents as Navy Ordnance, OSTD 599, *Preparation of Drawings and List of Drawings*; U. S. Army Ordnance Corp, *Engineering and Drafting Manual* ORDM4-4; *Draftsmen's Handbook*, Fire Control Design Division, Frankfort Arsenal, Vol. 1, and other similar publications.

The draftsman is not so much interested in the policies of MIL-D-70327 as he is in the detailed information that the drafting manuals contain. In other words, he is interested in the Services' interpretations of the Government standards. Military standards, however, are not written on a "do not" basis; they need interpretation. And each Government Service with a drafting manual, each company with a drafting standard, has a different way of interpreting the Government Standard. For example, if company "A" is the Government prime contractor, and company "B" is the subcontractor of "A," then "B" has to prepare drawings, not in accordance with Government standards and specifications, but with company "A's" interpretation of Government standards and specifications. As it now



NAVY OSTD 599 (1st Rev., 18 Feb. 57)	ARMY ORDM 4-4 (Change 2, 4 Mar. 59)
MATERIAL NOTE:	MATERIAL NOTE:
STEEL SPRING WIRE*, ..... QQ-W-474A**, ..... COMPOSITION C, ..... ANNEALED ..... HEAT TREAT TO RC 57, MEDIUM SUPPLY HEAT SHALL NOT CAUSE ANY DECARBURIZATION IN THE MATERIAL.	STEEL SPRING WIRE*, ..... COMPOSITION C, ..... ANNEALED ..... SPEC QQ-W-474** .....  HEAT TREATMENT NOTE:  HEAT TREAT TO RC 57, MEDIUM SUPPLYING HEAT SHALL NOT CAUSE ANY DECARBURIZATION IN THE MATERIAL.

- \* OSTD 599 (Examples Para. 10.3) Form of material always specified.  
ORDM 4-4 (Para. 140.6.2) Form of material specified *only* when it is a design requirement.
- \*\* OSTD 599 (Para. 10.1.2) Specification revision letter indicated "where a particular issue only is considered satisfactory."  
ORDM 4-4 (para. 140.6.4) "Specification number shall be indicated in the material note only by the basic number without revision or amendment indication."

stands, we have not one Standard, but as many standards as there are Service and company manuals.

We respectfully submit that unless MIL-D-70327 is complemented by a drafting manual, nothing is truly gained.

This drafting manual should not be three different (Air Force, Navy and Army) interpretations of MIL-D-70327. It should be a single Department of Defense Drafting Manual. If, for any reason, it should be necessary for the Services to have different interpretations, these should be included in the same manual. The drafting manual should include samples taken from actual drawings, to illustrate how and what information the Service wants on the drawing.

To illustrate the confused situation prevailing at the present time, let's analyze a drawing call-out as shown above.

The following additional differences also exist. (1) OSTD 599 combines heat treatment with material note, while ORDM 4-4 requires two separate notes. (2) Data must be presented in the order shown in the above examples, and it differs from one Service to another. (3) Specification number must be preceded by "SPEC" (without any period) in ORDM 4-4, while OSTD 599 does not require this.

Experience has shown that, when one works for the Government Services or for prime contractors, it is foolish not to consider compliance

with even the smallest detail.

It has, for example, been reported to me that drawings were rejected because:

- (1) "Radius" was abbreviated on the drawing as a capital "R" followed by a period; MIL-STD-12 does not require a period;
- (2) "QQ-A-325" was called "FED. SPEC. QQ-A-325;"
- (3) a decimal point, perfectly visible on the drawing, had not been especially darkened per MIL-STD-8A, para. 1.4.6;
- (4) "Aluminum" was abbreviated "Alum" per ANA Bull. 261, and not "AL" per MIL-STD-12;
- (5) a draftsman put "temper T6" instead of "T6 temper."

In addition to a drafting manual, we respectfully submit that MIL-D-70327 should also be supplemented by a Shop Practice Standard, so that we don't have a situation where the drill hole tolerance for Air Force jobs are per AND 10387, and for other Services per MIL-G-2550 (General Specification for Ammunition Except Small Arms Ammunition). Such a Shop Practice Standard would serve to eliminate many dimensions on the drawings and thus to reduce drafting costs.

Increased drafting costs will also result because MIL-D-70327 appears to apply not only to production drawings, but also to experimental breadboard drawings. At any rate, the title of the Specification—*Drawings, Engi-*

*neering and Associated Lists*—implies this.

If MIL-D-70327 applies only to production drawings and to experimental jobs slated for production, then some specification should clarify what standards are to be followed when MIL-D-70327 does not apply. A good solution would be a specification describing the drafting requirements in terms of model definitions such as drafting requirements, breadboard, experimental, developmental, service test, prototype and production models.

Drafting may be slowed up and the design may be hampered because of a MIL-D-70327 requirement that, unless otherwise agreed during negotiation, it is the design activity's responsibility to get a complete set of drawings and manufacturing data for vendor proprietary items.

This means that when a proprietary item is required to complete a particular design, the design engineer must stop and find out if all the necessary information per MIL-D-70327 is obtainable before proceeding. If the information is not available, they will have to look for another supplier of this same item, or redesign. The MIL-D-70327 requirement may reduce the number of bidders on some advanced electronic equipment; it may halt a design completely during its development stage, if the application of a sole-source item is a design necessity, and if that sole supplier refuses to divulge his trade secrets (particularly when they are not covered by a patent).

Compliance with MIL-D-70327 will require tremendous amounts of negotiation. Since negotiation costs time and money, this will be reflected by increased drafting costs.

In conclusion, I would like to address a few remarks to those in the Department of Defense. You are trying to do something that has never been done before. It is done in the interests of us all, and it is a difficult task. We admire your courage.

### The Author

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ARMORED amphibian assault vehicle turreted with 105mm howitzer (LVTH6).

# Bureau of Ships Transforms Engineering Drawings File

*Automated filing, retrieval, and reproduction system supplants manual control of drawings*

by Edward E. Moravec

FOR MANY YEARS engineering drawings have been prepared and processed in many different ways within the Department of Defense. Recently there has been increasing pressure on the Department to standardize the methods used in all Defense activities.\*

In an effort to provide more efficient and better facilities for the proc-

essing of its engineering drawings, the Marine Corps requested the Bureau of Ships, Department of the Navy, to establish a modernized drawing processing system, incorporating electric accounting machine card indexing, aperture cards with 35mm microfilm, and the various time and labor saving devices made possible by this system.

In line with this request, the Amphibious Vehicle Section of the Bureau of Ships has evaluated and adopted the microfilm and aperture card concept<sup>1</sup> for drawing reproduction and storage. This system was adopted to overcome the objections to the high cost of drawing and record reproduction, bulkiness, storage space requirements and filing



FIGURE 1. Blueprint file (left) vs. aperture card file for same data (right).

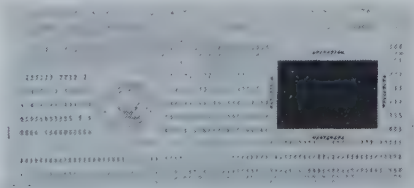


FIGURE 2. LVT Aperture Card.

\*Editor's Note: The March 1960 issue of *Graphic Science* carried a full report on the engineering drawings standardization program within the Department of Defense; see pp. 15 through 18, "Microfilming and Management of Engineering Documents," by William S. Hutchinson. See also "Notes and Comment" on page 10 of the June 1960 issue for a listing of specifications governing standardized military requirements for microfilming drawings, approved April 15, 1960.

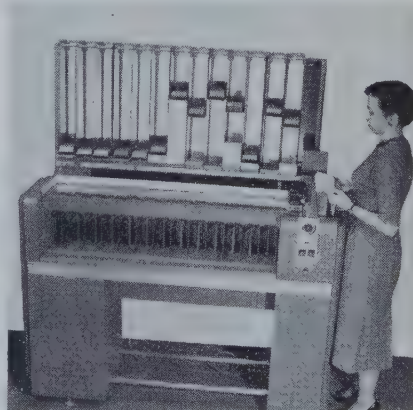


FIGURE 3. Clerk sorts LVT aperture cards for distribution prior to mounting.



(see Figure 1), and to eliminate the need for reproducibles and blueprints in certain applications. Aperture cards are used as a means of distributing drawings and records on unitized microfilm to those activities that require full-size, direct-reading copies only occasionally, and also to activities using such drawings and records primarily for reference or information purposes.

The blueprint method of reproduction has been discontinued, by the Amphibious Vehicle Section, as the means of distributing drawings and records to those activities that must have full-size, direct-reading copies and who use such drawings and records for reference, bidding, production or cataloging purposes. It has been replaced by the electrostatic dry process of reproducing hard copies from unitized microfilm.

#### HOW THE SYSTEM WORKS

**T**HE AMPHIBIOUS Vehicle Section aperture card (see Figure 2) has certain items of information punched in which permits filing, sorting (see Figure 3), researching and tabulating of the drawings portrayed on the microfilm.

The preparation and distribution of Landing Vehicle, Tracked (LVT) aperture cards are accomplished in five phases as follows: (1) microfilming of the drawing; (2) processing of the microfilm; (3) punching and interpreting data in the aperture cards; (4) mounting microfilm in the aperture cards; (5) inspecting and distributing sets of unitized microfilm aperture cards.

Microfilming of the LVT drawings (see Figure 4) was accomplished at the Amphibious Vehicle Design Agent's Plant (Ingersoll Kalamazoo Division, Borg-Warner Corporation, Kalamazoo, Michigan), under the supervision of Recordak Corporation, in accordance with specifications prepared by the Amphibious Vehicle Section. With 15 sets of aperture cards required for distribution to all activities concerned with the LVT program, the problem of duplicating the sets of microfilm was explored. It was decided to provide all activities with first generation microfilm in order to maintain a high standard of quality. This was accomplished by attaching a counter<sup>2</sup> to the microfilm camera so that by setting the counter and

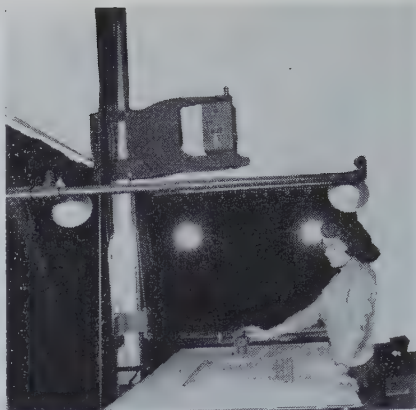


FIGURE 4. Operator checks density reading before photographing LVT drawing.



FIGURE 5. Operators keypunch information into master set of EAM cards.



FIGURE 6. Cards go through tabulating interpreter which prints punched data.



FIGURE 7. Microfilm is mounted in aperture cards using semiautomatic mounter.

pressing a release button the drawing is photographed as many times as may be required.

The rolls of exposed microfilm were put through a rigidly controlled processing system where each roll was carefully processed and inspected for adherence to specifications with respect to reduction ratio, resolution, background density and other controlling factors. While the rolls of microfilm were being processed, a master set of electric accounting machine cards was being key punched and interpreted (see Figure 5) with the drawing title, drawing number, revision letter and date, security classification and distribution code. The information for each card was obtained from work sheets that had been prepared by the camera operator during the period the drawing was being photographed 15 times.

The cards were then run through a tabulating interpreter (see Figure 6) which printed the previously punched data across the top of each card. Each master card was then verified by double-checking it against the microfilm images. The master cards were then run through a reproducer<sup>3</sup> to produce the fifteen sets of punched aperture cards required. The final step before distribution was to mount the microfilm frames into their respective cards. Each roll of film was passed through the semiautomatic mounter (see Figure 7) and the images were matched and mounted to their particular cards.

To keep the LVT aperture card program up-to-date, new drawings and revisions to old drawings will be microfilmed and mounted in aperture cards and furnished to LVT activities on a continuing basis. Thus all sets of aperture cards will be kept current with the master set maintained by the LVT Design Agent. This will contribute to a continual program of reduced cost, improved quality, faster service and less required filing space.

#### ADVANTAGES

**V**ALUABLE engineering time is saved in this program, by providing a compact system (see Figure 8) in which microfilm copies of all drawings and revisions thereto are filed in numerical sequence. Due to less demand for reference and reproduction, the original drawings can now be safely filed and protected.



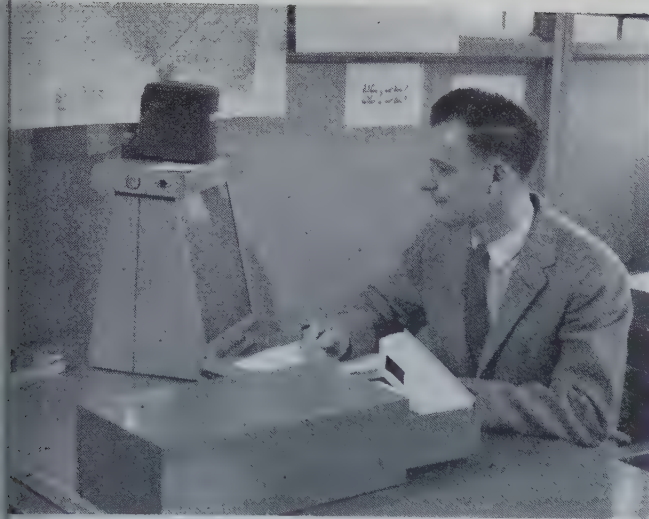


FIGURE 8. LVT project engineer uses compact viewing unit.



FIGURE 9. About 30,000 LVT drawings are within reach.

against loss and abuse, thereby materially reducing time formerly spent on redrawing. The revision procedure is simplified by altering the original drawing only, and creating in turn a superseded file of unitized microfilm images. These are filed in ascending numerical order behind the microfilm of the original drawing.

Appreciable savings in operational costs are realized by eliminating the need for full-size paper or cloth reproducible. The aperture card method allows the unitized microfilm to act as a master reproducible. The image can be enlarged photographically or electrostatically to full or reduced-size vellums, offset masters or sulfite paper prints. Reference and storage print requirements are reduced 90 per cent through the use of the microfilm mounted in aperture cards.

The method outlined provides fingertip accessibility to all LVT engineering drawings. The engineer who needs to refer to a drawing has only to select the proper card from the aperture card file and insert the card in a viewer<sup>4</sup> which projects the drawing image on the viewing screen (see Figure 9). Should the engineer require

a print for more extensive reference, a reproduction of the drawing can be made by an enlarger-printer<sup>5</sup> in less than 30 seconds (see Figure 10). Since these prints are inexpensive they are disposed of after use, thus eliminating any need for a print file.

The creation of this compact and

unitized microfilm file allows for faster handling and shipping of drawings for dissemination to the field, with an attendant savings in preparation and mailing costs (see Figure 11).

For some time, other phases of military programs have, wherever possible, used electric accounting machine (EAM) card processing. The aperture card fits into the over-all system and serves as a good basis for such additional EAM requirements as the Engineering Release, Provisioning, Stock Control, and Cross Reference.

The Bureau of Ships has established a rather complete equipment program wherein EAM cards are used extensively, although not exclusively. In practice, the design as depicted in the aperture card, is released by an EAM card. This release card and the microfilmed drawing together serve for preparation of a Provisioning List consisting of a set of four EAM cards. Due to the practice of assigning various manufacturers' numbers to the same item, an EAM Cross Reference deck has also been established.

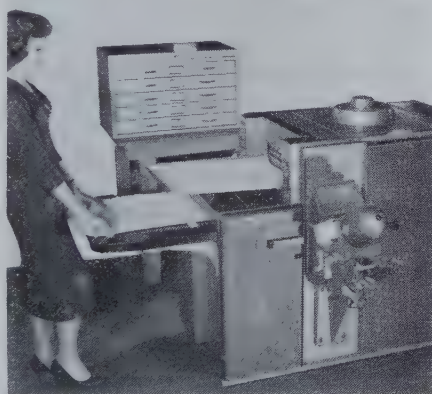


FIGURE 10. Making prints from LVT aperture cards with an enlarger-printer.



FIGURE 11. Mailing bulk of blueprints compared with that of aperture cards.

<sup>1</sup>Filmsort System, pioneered by The Filmsort Co., a division of Minnesota Mining and Manufacturing Co., St. Paul 6, Minn.

<sup>2</sup>Multiple Exposure Counter, produced by Recordak Corp., 415 Madison Ave., New York 17, N. Y.

<sup>3</sup>IBM Reproducer, manufactured by International Business Machines Corp., 590 Madison Ave., New York 22, N. Y.

<sup>4</sup>Filmsort Viewer, produced by The Filmsort Co., division of Minnesota Mining and Manufacturing Co., St. Paul 6, Minn.

<sup>5</sup>Bruning Copytron, 1000 Microfilm Enlarger-Printer, manufactured by Charles Bruning Co., Inc., Mount Prospect, Ill.

### The Author

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# Spring Drafting Principles

## Part III

### Torsion Springs

by Albert L. Godshall and Gerald L. Kilmer

**H**ELICAL torsion springs (Figure III-1) store energy by being twisted around the axis of winding. When permitted to release this energy they tend to unwind and exert a torque through arms or other connections at the ends.

The recommended spring specification form for verbally specifying torsion springs (Figure III-2) should be used with all torsion springs. In using the form, items 2 and 3 are the preferred torque requirements combination and should be used where possible. Do not specify more than two as this places impractical limitations upon the manufacturer. The space at the top of the form should be used to show angles of arms, initial and final, and other important considerations. The space at the bottom is used to note test requirements and other remarks.

All torsion springs are treated together here since it is not practical to discuss them separately.

Three dimensions should go on a torsion spring drawing: the initial and final angle of arms, true length of arms, and point of application of force.

The best view of a torsion spring—particularly the arms or ends—is often not the conventional right angle view. Instead, the best view is one taken normal to the various shapes, from which true dimensions can be obtained. This is so because true angles and true lengths are the only torsion spring dimensions which are of value to a spring manufacturer.

Another suggestion: always draw one arm, or end, either perpendicular or parallel to a center line.

There are no “standard” ends for torsion springs. Therefore, a detailed drawing must be supplied to the spring manufacturer.

Dimensioning a torsion spring end which is made up of a series of curves, twists, bends, etc., is often a problem. The best method of dimensioning

is to indicate the center-to-center distance between the curves of different radii. Consider, for example, a section which has a curve on either end. The point on the wire where the straight section ends and the curve begins is almost indeterminate. Therefore a dimension on the straight section doesn't tell the spring supplier as much as one between the centers of the two curves. Draftsmen have been known to use some rather strange dimensions, such as between points of tangency, measuring from the center line of the wire and measuring straights.

If a draftsman is at all concerned with the cost of the spring he is drawing, it is important that he consider the way arms or ends are formed in order to take advantage of the lower costs inherent in automatic forming. An end formed automatically adds little or nothing to the total cost of the spring. An end that cannot be formed automatically may cost more than all

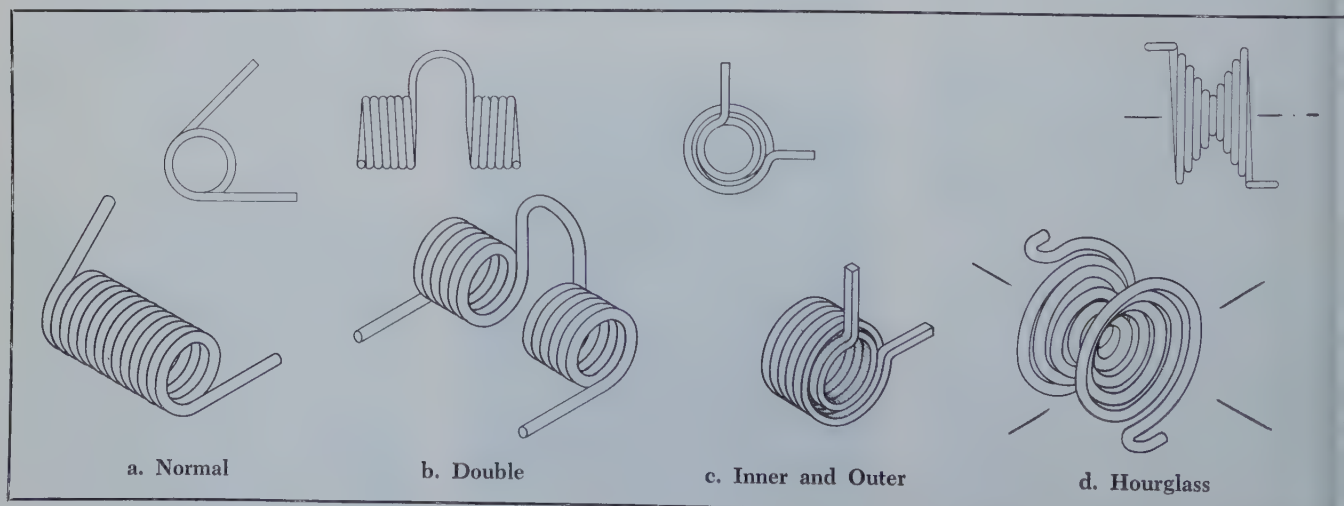
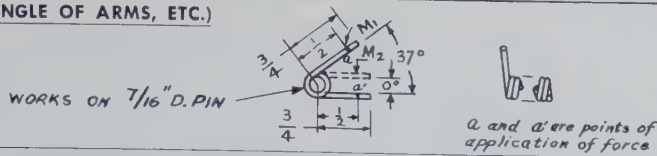


FIGURE III-1. Torsion Springs.



**SKETCH (ANGLE OF ARMS, ETC.)**



**TORQUE REQUIREMENTS—SPECIFY ONLY TWO** (ITEMS 2 & 3 ARE THE PREFERRED COMBINATION)

1. FREE ANGLE	DEG. $\pm$		DEG. (SEE SKETCH)	
2. INITIAL MOMENT	1.30 LB.-IN. $\pm$	0.21	LB.-IN. AT	37 DEG. ANGLE
3. FINAL MOMENT	1.72 LB.-IN. $\pm$	0.21	LB.-IN. AT	0 DEG. ANGLE
4. GRADIENT	LB.-IN. DEG. $\pm$		LB.-IN. DEG. BETWEEN	DEG.
AND	DEG. OR		DEG. $\pm$	DEG. DEFLECTION BETWEEN
	LB.-IN. INITIAL MOMENT AND			LB.-IN. ADDITIONAL MOMENT

**SERVICE REQUIREMENTS**

SPRING MUST OPERATE A MINIMUM OF 100,000 CYCLES BETWEEN 1.30 LB.-IN. AND 1.72 LB.-IN.  
 MAXIMUM STRESSED POSITION 0 DEG. (FOR ASSEMBLY, ETC.)  
 SPECIAL \_\_\_\_\_  
 (LOAD REQUIREMENTS MUST BE MAINTAINED AFTER ABOVE SERVICE REQUIREMENTS HAVE BEEN FULFILLED.)

**PHYSICAL SPECIFICATIONS**

MIN. I.D. .456 IN. FOR .437 IN. DIA. SHAFT (MUST BE GIVEN IF TEST TORQUE IS SPECIFIED)  
 MAX. O.D. \_\_\_\_\_ IN. FOR \_\_\_\_\_ IN. DIA. CAVITY  
 FREE LENGTH OF COILED BODY .375 IN. MAX. IF CLOSE WOUND  
 \_\_\_\_\_ IN.  $\pm$  \_\_\_\_\_ IN. IF OPEN WOUND  
 MATERIAL MUSIC WIRE FINISH PLAIN  
 TYPE OF ARMS (SHOW INITIAL AND FINAL ANGLE ON SKETCH) STRAIGHT DIRECTION OF HELIX LEFT

**CALCULATED VALUES**

WIRE DIA. .047 IN.  $\pm 3\%$  OUTSIDE DIAMETER .603 IN. GRADIENT .01135 LB.-IN./DEG.  
 FREE LENGTH 0.333 IN. ACTIVE COILS 6.089  
 "FOR DIAMETERS UNDER .034", NOMINAL WIRE DIAMETER MAY BE VARIED .001" SO LONG AS ALL OTHER REQUIREMENTS ARE MET.

**REMARKS** (SPECIFY TEST REQUIREMENTS: ARBOR SIZE, LOAD CONTACT POINT, OTHERS.)

USE 0.437" DIA. ARBOR LOAD AS SHOWN ON SKETCH

FIGURE III-2. Form for specifying torsion springs.

Fig. 7. The end of this spring is bent in, perpendicular to the axis of the spring. This end can be any length but is usually less than the OD of the spring. Also, if the end is shorter than 4 times the wire size, it is usually necessary to cut the end. This type can be produced automatically on one end of the spring only. The other end can have any of the other types illustrated except that shown in Fig. 10.



Fig. 8. The end of this spring is bent out radially away from the body of the spring.

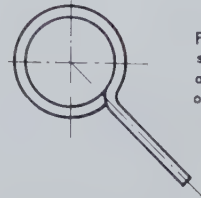


Fig. 9. The end of this spring has a 180° hook near the body. The length of the return end A must be at least twice B to permit 180° forming without recutting.

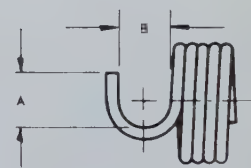
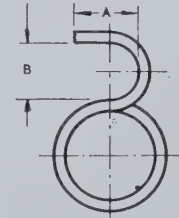


Fig. 10. This end is similar to that shown in Fig. 9 except for the fact that the hook is turned in the direction of the spring axis. As in Fig. 9, the length of A should be at least twice that of B. This end can be made only when the spring index is greater than 10. This type can be produced automatically on one end of the spring only. The other end can have any of the other types illustrated except that shown in Fig. 7.

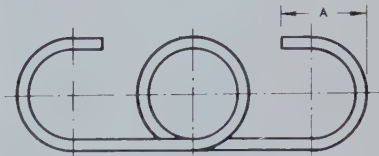


Fig. 11. Hooks of this type on the ends of the arms can best be made when they are the same diameter as the coil. On one or both ends "A" must be equal to the OD of the spring to avoid a cutting operation. This type of end is unlikely to be required and should be avoided in favor of Fig. 3 wherever possible.



Fig. 12. This spring is formed on a special arbor to produce the unusual shape of the coil. The forming of the arms is done as described in Fig. 6.

of the other operations together. Figure III-3 illustrates some of the types of torsion spring arms or ends which

can be formed automatically if the quantity is sufficient to warrant some special tooling for the machine.

(To be continued)

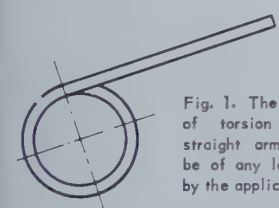


Fig. 1. The simplest form of torsion spring has straight arms which may be of any length required by the application.

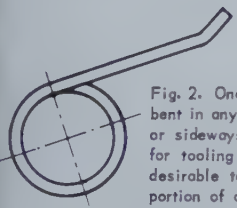


Fig. 2. One or both arms can be bent in any direction, up, down, or sideways. To provide space for tooling for the bend, it is desirable to specify a straight portion of arm equal to one OD of the spring.

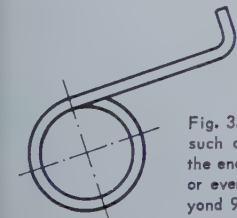


Fig. 3. On a straight arm, such as shown in Fig. 1, the end can be bent square or even a few degrees beyond 90° in any direction.

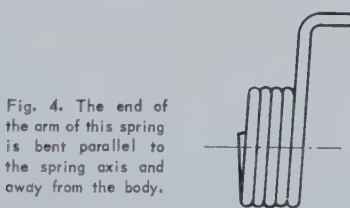


Fig. 4. The end of the arm of this spring is bent parallel to the spring axis and away from the body.

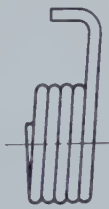


Fig. 5. The end of the arm of this spring is bent parallel to the spring axis and in, toward the body. This may be more difficult to make than the type end shown in Fig. 4.



Fig. 6. On this spring, one or both arms can be die formed. Various shapes can be formed on the ends of the spring to fit design requirements.

FIGURE III-3. Types of torsion spring arms and ends formed automatically.



# *Critical Analysis of MIL-D-70327*

*A survey of significant requirements of this  
new specification as they relate to drafting*

by W. W. Thomas

**T**WO-AND-ONE-HALF years ago there were 154 known specifications covering how to make a drawing for the U.S. Military. The practice at that time was to bid every contract individually and to set up drafting rooms for each special requirement.

The Department of Defense has taken as its objective the standardization of drawing practices used in military departments and by their contractors. MIL - D - 70327 is now being called out in contracts. It will, inevitably, become a part of our routine and it is going to change our company's daily life. It will affect, at the very least, such functions as sales contracts, administration, legal procurement, engineering and manufacturing.

A general specification, 70327 outlines the minimum requirements which the Military believes necessary for drawings. It is a mere 25 pages in length, but it invokes most of the low-numbered Military Standards such as 1, 2, 3, and 4. As a result, the complete document with appended standards represents 586 pages of requirements.

There are still some ambiguous paragraphs in 70327. Since it has not

yet had wide usage, we are still not sure how they will be interpreted. In some instances, downright objectionable features exist which do not represent good business. It should be approached as a strong step forward, but one still containing pitfalls for management and for drafting departments alike. These must be carefully analyzed, and in some cases adjusted by contract negotiation.

## SCOPE

**F**IRST OF ALL, the scope of this new Spec does not limit its application to production drawings. We are aware that the Military would like to invoke it on a good bit more than production drawings—on experimental or R&D contracts for example. Management and marketing are probably going to have to face up to the decision as to whether they can afford the luxury of going back to re-doing their original experimental drawings when follow-on production contracts have been received.

The Military has been quite uniform throughout Project 70327 in stating that they are not getting adequate drawings. The new "scope" and "intended use" clauses of this Spec

say that drawings are for design procurement, manufacturing, test, evaluation, production, production and receiving inspection, overhaul, shipping, storage, identification of stock, ordering and storage of replacement parts, inspection of items at overhaul, general maintenance of equipment, construction, survey, and *wherever engineering drawings are needed*. This scope, in our opinion, far exceeds the scope of most previous drawing specifications. It shows a rather clearcut intention on the part of the Military to get drawings and related data which completely delineate the part.

The second new feature of this Specification is the combination, in one document, of requirements for drawings made by the Military and by industry. There should be no difference, except for the name and the drawing number, between a drawing made for the Army Ordnance Corps or for the Air Force. Contractors will continue to retain Class 2 drawings and probably to deliver originals of Class 1 to the services who bought them.

Third, this document invokes a new requirement for lists, such as separate parts lists, index lists, data lists and shipping lists, through the invocation



of a new MIL-STD-30. We believe that industry will have relatively little difficulty in working to what will eventually be found acceptable by the Military, but we are sure we cannot accept MIL-STD-30 as it stands.

In several paragraphs of the Specification the language is quite confusing regarding the amount of detail necessary for drawings. Most of the requirements for detail represent an attempt to inject the philosophy of information sufficient to re-procure from competitive sources. The language is so misleading in these areas that we believe it will be necessary to negotiate into each contract some clear interpretive language which will permit a continuation of our present drafting practices. Without such language we could well have very serious and unsuspected requirements invoked on us at a local inspection level.

Regarding Specification Control Drawings, the new document has introduced some confusing language also; this is partly through the introduction of a source control drawing. This new concept will require definitive interpretation in the contract to obtain assurances that present practices will be satisfactory.

One of the most serious ramifications of MIL-D-70327 lies in the establishment of the subcontractor's relationships. The Military has, by this document, made it the responsibility of the prime contractor to include in his contract or orders with subcontractors, a requirement that all of the subcontractors' drawings be prepared in accordance with the new specification.

Further, the document makes it the responsibility of the prime to submit complete vendor details satisfactory for parts manufacture, without regard as to whether the component is a repairable or a non-repairable assembly. The Military expresses a definite preference for submittal of vendor data through the prime by including a requirement that if data is source-inspected and submitted directly, such shipment must have prior approval by the Military. In all of our contracts to date, there has been some provision for protection of the prime, should a vendor flatly refuse to furnish this data. No such provision exists in this document, and in repeated discussions with all of the military activities, we have been assured that none was intended.

Another serious change in general thinking regarding drafting that is created by this new Specification, is a requirement that the prime contractor establish and maintain adequate procedure for checking review, and maintenance of drawings and associated lists. This is indicative of a strong desire within all military activities to "beef up" and to make more specific the prime contractor's full responsibility for adherence of drawings to the letter of military specifications.

Under this new Specification, several contracting decisions must be made which we haven't had to make in the past. We will now have to decide which of the two types of drawings is to be furnished, what type of index list is required, what kind of material the originals shall be drawn on, and—in some cases—what kind of prints are required. We will have to get a decision on whether our approval control and change control procedures are satisfactory to the branch of service affected. We will, more than ever, have to be sure that our proprietary rights are protected.

A new burden is placed on contract administration in this area. If we are to have one contract one way, and the next contract another, our drafting rooms will be faced with different requirements for each contract because of the options allowed. Thus, we might be back almost to the original dilemma—that of having different drawing practices for each branch of the service.

#### MANAGEMENT'S RESPONSIBILITIES

TOP MANAGEMENT must recognize a tendency toward cost increases as negotiations in this area increase. More specs are being read more closely, and demands are being made for higher quality and for more strict compliance. Vendors must be brought aboard the quality bandwagon; in many cases, purchase orders with small vendors may require face-to-face discussion before an understanding is reached. In the average company, records will probably be increased. Certainly, auditable records on checking will have to be kept. In some cases, non-existent or weak drafting manuals will have to be strengthened to agree with contractual obligations. All this costs money. It will be up to top management to recognize this shift in emphasis and to provide for

it. At the very least, management must not increase the difficulties of drafting managers by violently resisting this shift at home, while they are buying in on contracts which demand it. Small companies will be well advised to consult closely with their associated primes or with qualified consultants.

What is the effect of this new document on the sales, marketing, and legal functions of a company? First of all, marketing must understand the vital need for consistency when buying in on options that can affect drafting practices. Consistency in this area is the only way a company will be able to make one drafting standard do for contracts with all military services.

Second, the marketing department should realize that the ambiguous language in the drafting details of this Specification require adherence to a closely coordinated military Interpretations Document. This document should be referenced in basic agreements or in all contracts.

Marketing must also take a close look at R&D-type contracts to see whether the Military intends that these have full Specification-type drawings. We think that the Military will try to extend the application of this Specification into the R&D development design areas, whenever they believe follow-on contracts are a possibility.

The marketing and legal departments must bring drafting management into their thinking as early as is practical in the general area of Proprietary Rights. Without this information, drafting and design can quite inadvertently destroy all of the fine negotiations in these areas by failing to protect properly with placards.

The new Specification, completed shortly after ASPR IX, Part 2, declares only that proprietary data is to be furnished in accordance with the terms of the contract. Thus, the drafting rooms must be aware of proprietary protection written into a contract, and must be organized to implement the contract satisfactorily. To be protected, decisions on proprietary disclosures must be made so that the drawings making these disclosures are properly placarded early in the life of the contract. Drawing rules must be set up early in the contract; they must be clear, and they must be followed religiously.



THE EFFECT of the Specification in the engineering and drafting departments is not quite so dramatic, but problems will exist.

To begin with, drawing quality will continue to be a major problem. There is little doubt that those who have no drawing inspection system (empty-headed checking as compared with design checking) will have to develop one.

Although drawing media are now being covered by the Spec, no special problems should exist in this regard unless very cheap material is being used.

Caution is recommended for those using undimensioned drawings. They may lose all the savings of this process because of requirements that call for a world-wide distribution of stable reproducible at a high cost per-square-foot.

Reproduction problems are becoming more complex, probably not because of 70327, but because of constant forward strides in the state of reproduction art. Aperture card microfilm, introduced simultaneously by several branches of service with 70327, makes demands on drafting legibility by calling for higher quality duplicates, used as "originals."

In addition, there are a number of detailed drafting practices that change slightly, or add to present drafting effort. As an example of this, we might cite the requirement—new for many—that bulk material quantities be called out on drawings; and the requirement—new for all of us—that a vendor's code identification be placed adjacent to the drawing number block, replacing the vendor's name and address. This sort of detail, while troublesome, should be readily absorbed into company drafting practices without serious cost increase. Drafting management will be able to handle this as a normal routine.

Specification 70327 has serious effects on the procurement activities; purchasing management must become aware of this.

Primes must now get complete vendor's data; where new, this must be drawn to specification. Thus, in many companies, purchasing has for the first time, a real need to negotiate for this material. Absolute Spec adherence will bring data costs higher, and

will require price evaluation of the combined material and data package in competitive bids.

Purchasing is cautioned that a commitment for material alone places the prime in a sole-source position for related data. This situation cannot help but have a sobering influence upon some of the fast-procurement-without-data which takes place. The military people—en masse—tell us that if the vendor refuses Spec data, we are to find a new vendor.

Most points of concern to financial and accounting departments are probably clear by now. However, they include at least a need for the following:

1. Methods of estimating and bidding costs for data to the new Spec.
2. Methods of budgeting and collecting charges made on Purchase Orders where both material and data are bought. Budget problems probably demand separation of these charges.
3. Establishment of accounting systems which prove development of proprietary items under private funds on commercial work.
4. Financial may be interested in establishing reserve funds to cover the company for its responsibilities where uncooperative vendors prevent the meeting of contract commitments. Such reserves may have tax implications which bear investigation.

#### MILITARY ATTITUDES

THERE ARE a series of military attitudes developing. These attitudes are not as yet documented, but we record them here because, during the course of our work with the Military on this Spec, we have heard them repeated, preached, and expressed as doctrine. A knowledge of them will serve only as a guide to what we have sensed behind-the-scenes.

1. A general across-the-board dissatisfaction with present drawing quality exists among the Military. The remarks aren't complimentary. The samples they showed us weren't, either. Blowback from aperture card microfilm will make things worse.

2. There seems to be a strong tendency towards a requirement for better records. Past contractors for Army Ordnance and Navy Bureau of Ordnance should have no trouble; but contractors who have worked for the Air Force, Navy Bureau of Aero-

nautics, etc., will probably find pressure in this area toward something closer to the Army Ordnance's standards for records.

3. Reprocurement to competitive bid has been a byword throughout all of our discussions. The Government representatives who sat in on writing this Specification claim that Federal Law demands that, when they buy an article, they obtain drawings adequate for manufacture, or for competitive reprocurement. The new drawing Spec is intended to require this, with exceptions such as proprietary rights; these would be excluded by contract. This area should be much more clearly defined in writing any contract.

#### THE FUTURE

NO DISCUSSION such as this would be complete without extrapolation of the existing progress and problems into a prediction of future developments in the drafting and technical data field. Some of the things we believe can be expected in the foreseeable future are given below.

1. We can look for a rash of more stringent—although uniform—original drawing storage provisions. Those of us who have four-hour fireproof vaults will have no trouble; however, activities who store original drawings on sawbuck tables in the basement will have to expect a capital expenditure.

2. We can probably expect a relaxation of requirements in the Naval Bureau of Weapons and Army Ordnance to allow Class II drawings with contractors' drawing numbers instead of ordnance drawing numbers.

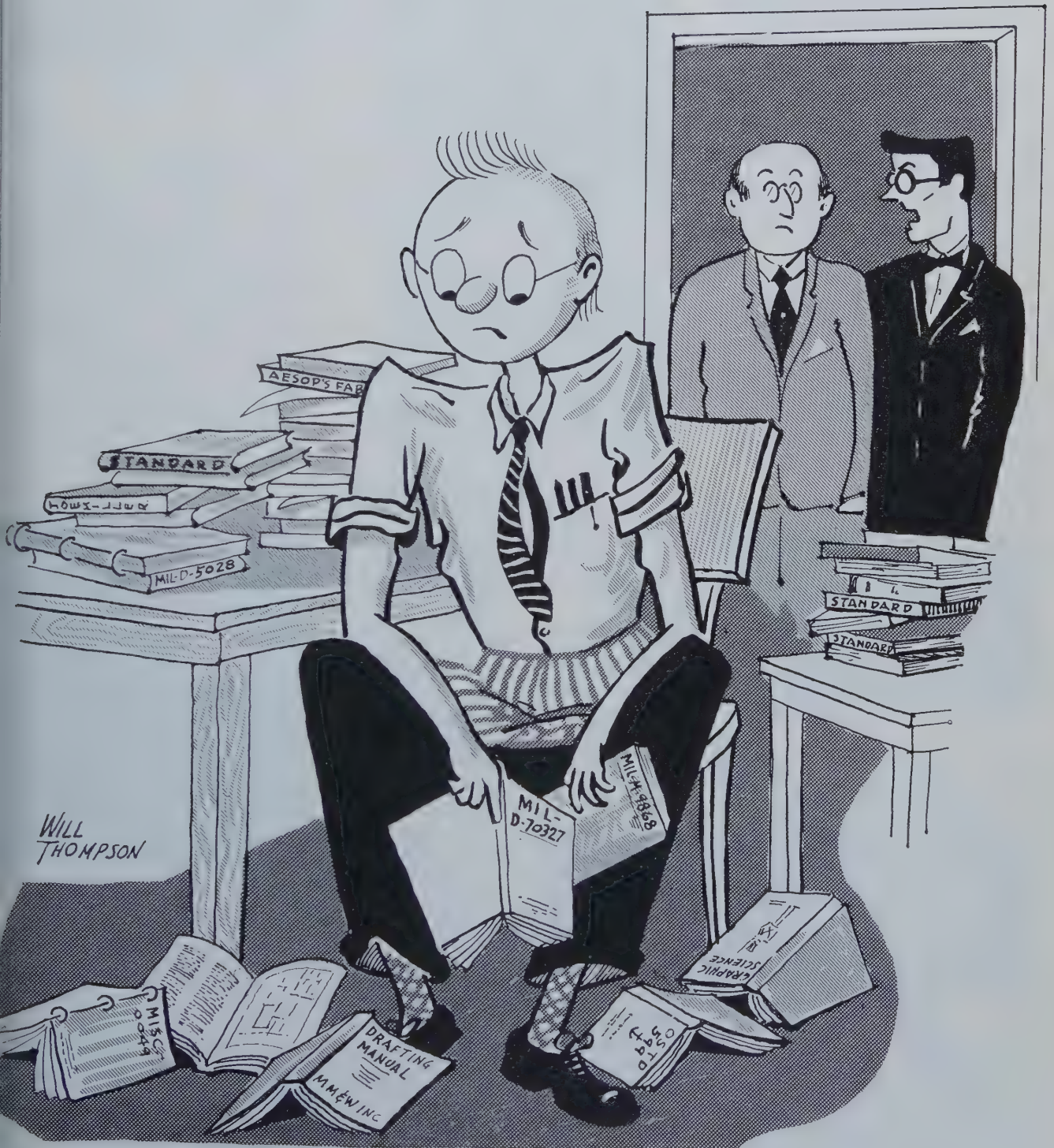
3. We will probably see much pressure for more EAM/EDP (electric accounting machine / electronic data processing) handling of list-type data. This will possibly lead to more controlled requirements in this area. It is hoped that 70327 will make this identical for all branches of the service.

4. I can see a demand developing for more highly refined change control systems. While this area of the new Specification allows a corporation to exercise considerable judgment at this time, I suspect that mechanization of data handling processes within the Government could well lead to more elaborate and restrictive controls.

5. There appears to be no doubt that within five to ten years, military submittals will be in aperture card

(Continued on page 26)





*"I told him to take a few minutes to familiarize himself . . ."*



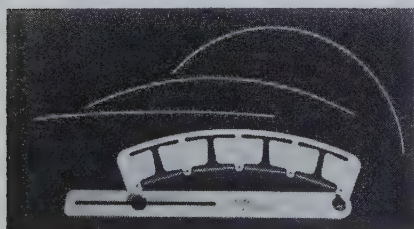
# New Products

## Drawing Ink Remover

Safe removal of India ink, regular ink, copying pencil, ballpoint pen, stamp pad ink and carbon smears, may be accomplished with a liquid correction agent recently introduced by Alvin & Company, Inc., 611 Palisado Ave., Windsor, Conn. Called X-A Remover, the eradicator is formulated for use on all types of tracing papers, vellums, cloths and plastics film. It dries quickly, permitting redrawing over corrected areas almost immediately. X-A Remover is also said to be an excellent cleaner for drawing instruments.

## Microfilmer

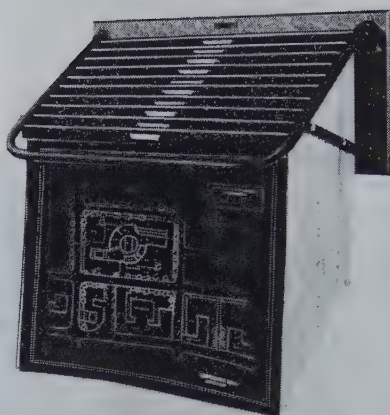
An automatic 16mm microfilmer that can handle up to 185 letter-sized documents per minute, has been introduced by Recordak, Subs. of Eastman Kodak Co., 415 Madison Ave., New York 17, N. Y. The new machine features a removable and interchangeable film unit.



## Arc Ruler

Arcs of circles with large radii can be drawn accurately with a new tool called Acu Arc Ruler. According to its designers, Fullerton Engineering Sales Co., 4623 York Blvd., Los Angeles 41, Calif., the device may be used to draw arcs of circles of any radius from 7 to 200 inches or more, even if the center point of the circle is beyond the edge of the drawing surface. A movable pointer on a scale reading radius length directly, gives the exact arc required. A chart is provided to convert the radius readings to civil engineers' scales.

*(For additional information regarding the new products described here, contact the manufacturer directly. Complete addresses are included.)*



## Wall-Type Drawing File

The user can work efficiently with a large number of prints or drawings when they are stored in the Martin Sheet File System unit. This patented, wall-type drawing file is now being manufactured, under licensed agreement, by Lewbill Industries, Inc., 81 Spring St., Scottdale, Penna. Many prints can be clamped firmly in each hanger; rubber-tipped lock clips are used to mount the sheets. Prints are said to hang flat, with no curl, and to be easily removable.

## Lettering Instrument

A simple, lightweight guide-line instrument, useful for students learning to master legible lettering, is offered by The O. A. Olson Mfg. Co., 712 Tenth St., Ames, Iowa. It consists of a transparent celluloid disc in a wire frame. The frame is set against a T-square, and the holes in the disc—which may be rotated—enable the student to draw guide lines for three different systems of lettering. This Ames lettering instrument will establish guide lines for letters varying in height from  $1/16''$  to  $1\frac{1}{2}''$ . It also provides for the two different lettering slopes preferred by most draftsmen, approximately  $68^\circ$  and  $75^\circ$ . The center column can be used for cross-sectioning, and for drawing brick, siding, shingles, etc.

## Isometric Gear Guide

Underlay drawing aids, designed for speed isometric drawing of spur, helical, bevel, internal, herringbone and worm gears, as well as racks, splines, ratchets, and sprockets, is offered by Graphicraft, P.O. Box 509, Westport, Conn. These are printed on durable coated stock. They may also be used for perspective projection.

## Drafting Machine

The working features of a T-square protractor, various scales and triangles, are combined in a single unit produced by V. & E. Mfg. Co., 7507 766 S. Fair Oaks Ave., Pasadena 12, Calif. The Vemco Drafting Machine is available with either standard drafting head, or with a special civil engineers' drafting head for extreme accuracy in mapmaking. Spring counterbalance and brake make Vemco machines suitable for use on inclined boards.

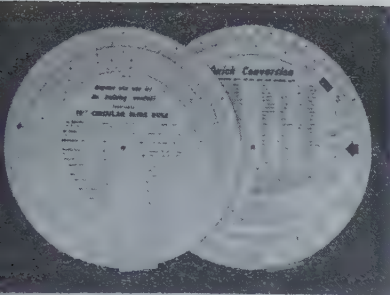


## Magnifying Lamp

Inspection lamp with 22-inch C-clamp light and 5-inch magnifying lens, contained in a swivel shade, has been designed for use where intricate work is being done. Called Model M-1C, the lamp is manufactured by Swinburn O-Lite Inc., 13 Moonachie Blvd., Hackensack, N. J. The head of the unit swivels  $354^\circ$ ; the arms of the lamp are also adjustable. The Model M-1C can be obtained with clamp, wall, or pedestal mount.



## New Products

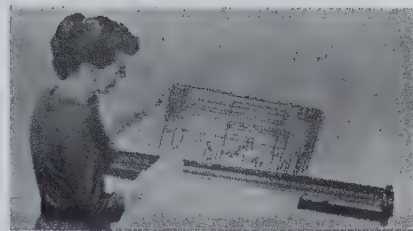
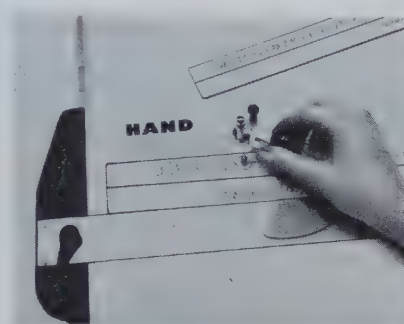


### Circular Slide-Rule Calculator

Engineers and students will be interested in a pocket-sized calculating device that is said to offer all the advantages of a conventional 15-inch slide rule. The unbreakable, 6½-inch diameter calculator is available from the National Calculator Co., Boulder 15, Colo., for one dollar, postpaid. Functions that may be performed on it include multiplication, division, reciprocals, proportions, square and square roots, cube and cube roots, circumference and areas. Complete conversion tables are also included.

### Lettering Templates

Two new templates for use with the adjustable Letterguide scribe have been announced by The Letterguide Co., 2709-O St., Lincoln, Neb. The first addition is a new series of 118 templates which extend the range of letter sizes from 3/16 inch to 3/4 inch in all their 40 alphabets. The second addition to the Letterguide line is "Fine Groove" engraving, now available in all 3/16-, 4/16 and 6/16-inch templates for use where greater precision is desired.



### Developer Units

Two new, low-cost, developer units designed for use with the Copyflex Model 42 Exposure Unit have been announced by Charles Bruning Co., Inc., Mount Prospect, Ill. The Copyflex Model 44 Developer machine (shown here) makes diazo prints. It takes sheets up to 42 inches wide and develops at a speed of 6 fpm.

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## New Literature

**Pre-Printed Symbols on Heat-Resistant Acetate**, a 62-page catalog, is offered by Mico/Type Inc., 6551 Sunset Blvd., Los Angeles 28, Calif. Over 1,000 pre-printed type faces, electronic symbols, arrows, screens and miscellaneous symbols are included.

**Engineering Planfiles Catalog** (AD-C2440-58) tells the complete story of the compact and portable units designed and built by Art-Metal Construction Co., Jamestown, N. Y., for the vertical accommodation of architectural and engineering prints.

(Copies of the literature reviewed can be obtained directly from the manufacturer or publisher. Complete addresses are included.)

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**Photographic Enlargement Process Brochure**, titled *Rapid Enlargement of Microfilms and Instantaneous Processing by the Rollacopy Process*, offered by Andrews Paper & Chemical Co., Inc., P.O. Box 528, 676 Northern Blvd., Great Neck, N. Y. The Rollacopy Process described in the brochure was perfected by Ets. Baucher et Co. in France. It is said to be a combination of classic photographic principles with new stabilization processing techniques, resulting in the rapid enlargement of microfilms.

**Projection Paper Brochure** (Form No. 21060-5) describes Projection Monocopy paper that permits positive work prints to be made directly from negative microfilm. The brochure offered by Anken Film Co., Subs. of Anken Chemical & Film Corp., Newton, N. J.

**Current Research and Developments in Scientific Documentation, Report No. 5**, (NSF-59-54), is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at a charge of 50 cents. All pertinent activities in the U. S. that have come to the attention of the National Science Foundation are included. The descriptive statements—in most cases written by research workers themselves—are classified under five subject headings: (1) Information Requirements and Uses; (2) Research on Information Storage and Retrieval; (3) Mechanical Translation; (4) Equipment Development; and (5) Miscellaneous.

**Xerographic Continuous Printers Brochure** (X-300 10M-12-59), describing three models of the Copyflo 11 Continuous Printer, may be obtained from Haloid Xerox, Inc., Rochester, N. Y. These automatic printers operate on the electrostatic principles of xerography and turn out positive prints, 11 inches wide, at the rate of 20 lines fpm. Model 1 reproduces only from roll microfilm; Model 2 reproduces only from original documents; and Model 3 (with interchangeable heads) reproduces from either roll microfilm or originals.





## Counterbalanced Board

*It may be adjusted to any height, and to any position, from flat to vertical*

**T**HE TIRING effects of bending over a stationary drafting board are eliminated by use of a drafting table which can be set at any height, or angle. The Isis Supra Drafting Table, shown here with an Isis drafting machine installed, are products of Schmidt & Laensch of West Berlin; they are available in the United States from Isis Incorporated, Box 1062, York, Penna.

According to the manufacturer, this type of equipment is used with practically no exceptions in European industry. The board is balanced in every position by a counterweight; effortless manipulation is said to result. The board is locked or released by a brake pedal the width of the stand. An adjustment is provided to take up wear on the brake mechanism. If desired, the board angle can be fixed by means of a hand knob, allowing only up and down movement. The base of the table consists of iron castings and machined steel parts that are bolted together to a rigid frame. The drafting board is of first grade, seasoned lumber, built up in construction to minimize warping. A wooden trough is provided for drafting instruments.

Isis drafting machines are designed for either vertical or horizontal boards. Drafting machines for use on vertical or inclined boards have a balancing weight rather than a spring or friction brake. The system of movement of the precision protractor head is by means of metal bars, which form parallelograms and pivot on pre-loaded ball bearings. No metal bands are used in the guiding system; adjustments are said to be completely unnecessary.

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soft ← → hard

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(Continued from page 20)

microfilm, with all Government prints becoming blowbacks from these films.

6. Unfortunately, we can also foresee more detailed requirements for such things as lettering slant, letter height, line quality (line density, if a measuring device can be developed), line width, etc. We sense a distinct trend toward the establishment of such rules instead of the establishment of overall quality requirements. While we continue to recommend against such action, we are having relatively little success.

7. Another possibility is the auditing of drafting manuals and procedures, with particular emphasis on check lists and checking procedures. Such actions might lead to mandatory checking organizations.

8. There is a trend toward greater

emphasis on the responsibilities of the prime to get the subs "on the ball" in the drawing area. I am not sure such a thing is practical in a commercial economy, but it is certainly being tried on us by the Military at this time.

This, then, is the story of MIL-D-70327. There are problems galore, but these are not without great long-range gain. Two-and-one-half years ago, most of us would have said that the combination of 154 documents was impossible. Today it is a reality—in spite of a number of remaining problems. For some, costs may increase. For many—particularly those who work for more than one branch of the service—the eventual gain (after we get out of the steep part of the learning curve) promises to be of staggering proportions.

There is no question in my mind that, as taxpayers, we will gain by the increased uniformity that is bound to grow out of the program.

## The Author

W. W. THOMAS, an aeronautical engineer, is Administrator, Drafting Coordination at Radio Corporation of America, Moorestown, N. J. He is member of I.A.S., S.A.E., A.S.M., and A.O.A. Since its inception he has served on the Department of Defense Industry *Ad Hoc* Group for Project 70327. At present, he is a member of the D.O.D. Drafting Standards Advisory Group, and the D.O.D. Drafting Standards Committee, as a representative of the A.O.A.

## CORRECTION

### True Position Dimensioning

Sirs:

Upon reviewing the May issue of *GRAPHIC SCIENCE*, I was greatly impressed by the "True Position Dimensioning" article. Proven tables of this caliber are a great time saver and we would like to see more of them in future issues.

On page 18, Note 3 states that washers are required under both head of screw and nut, with designation to be used with both Case 2 and Case 4. Pages 16 and 17 show Case 2 and 4 as having tapped plates, thereby eliminating the possibility of using nuts and washers. I would appreciate knowing if this designation was to refer to Case

1 and Case 3 where washers could be used under the nuts, or Case 2 and 4 with washers under the head of the screw only.

ROBERT M. HOSKO

Bus Duct Engineer  
Federal Pacific Electric Company  
Post Office Box 1510  
Scranton 2, Pennsylvania

Sirs:

Regarding your article, "True Position Dimensioning": On page 17, Case 3, upper left hand dimension, should .800 be .880?; same page, bottom right dimension, should that be .848 instead of .348 on Case 4?

J. J. FLAHERTY

Chief Draftsman  
Cornell-Dubilier

Research Center  
921 Providence H'way  
Norwood, Mass.

**EDITOR'S NOTE:** Mr. Friedrich, author of the article, replies, "Corrected Note 3, page 18, should read, 'Holes marked as shown require washers under the head of screw, also required under nut in Cases 1 and 3.' My thanks to Mr. Flaherty, Chief Draftsman, and Mr. Hosko, Engineer, for calling our attention to the errors on page 17 and 18. Our face is very red. We were so concerned with getting the table on page 18 to check out correctly, that we did not pay enough attention to the case illustrations."

WALTER H. FRIEDRICH  
The Magnavox Company

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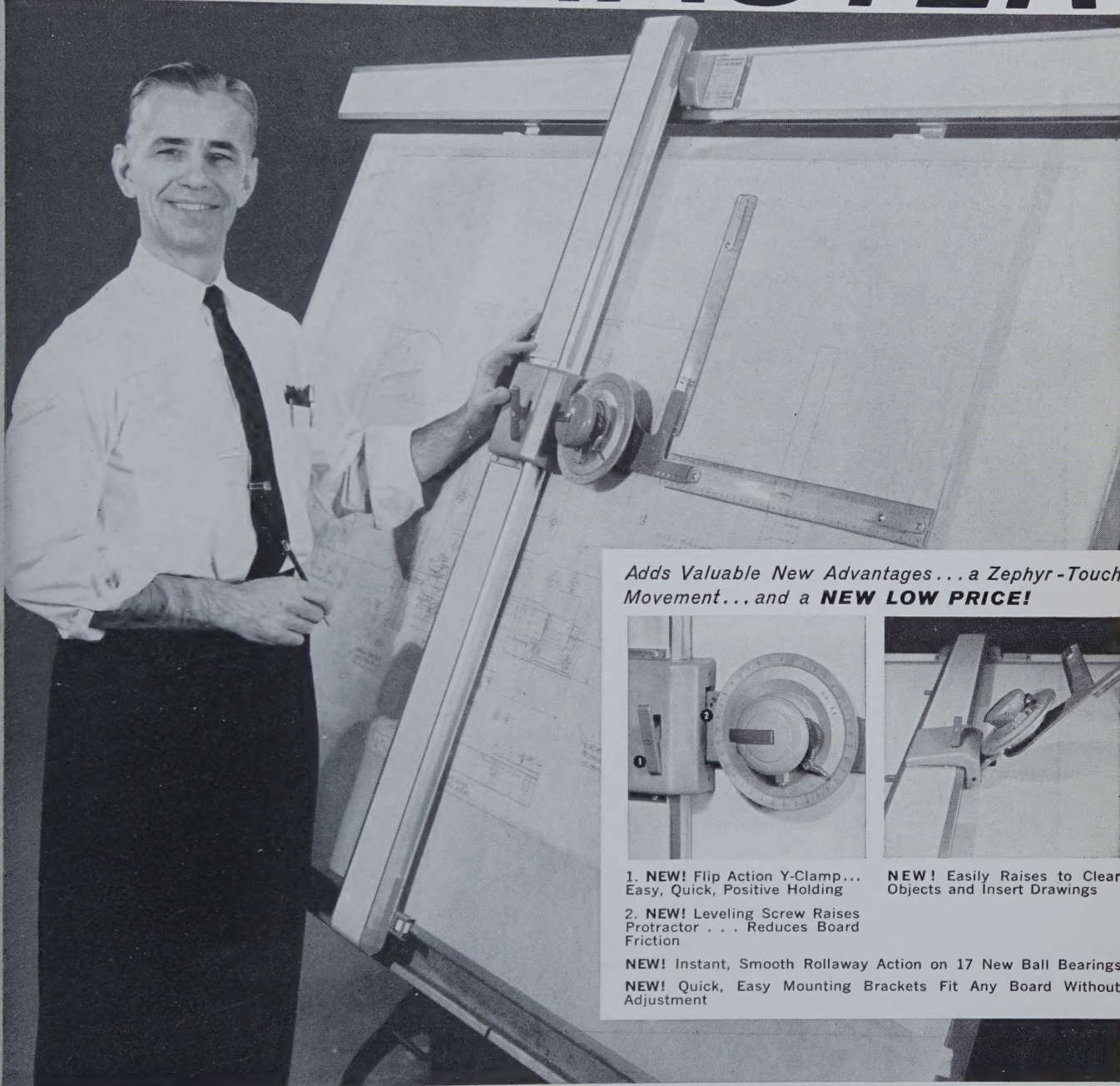
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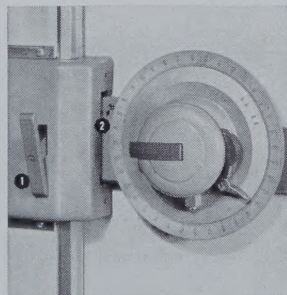
The best design...

for better drafting... UNIVERSAL'S

# NEW 60 TRACMASTER

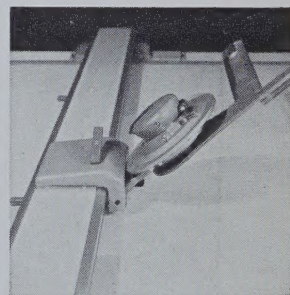


Adds Valuable New Advantages... a Zephyr-Touch Movement... and a **NEW LOW PRICE!**



1. **NEW!** Flip Action Y-Clamp... Easy, Quick, Positive Holding

2. **NEW!** Leveling Screw Raises Protractor... Reduces Board Friction



**NEW!** Easily Raises to Clear Objects and Insert Drawings

**NEW!** Instant, Smooth Rollaway Action on 17 New Ball Bearings

**NEW!** Quick, Easy Mounting Brackets Fit Any Board Without Adjustment

## Plus Tracmaster's Proven Features of Superiority!

- ★ Rugged Beam Rail Construction Provides Essential Rigidity and Strength for True Tracking
- ★ Protected Rails Assure Longer Life Accuracy
- ★ Perfect Balance at ANY Board Angle... Anyplace on the Board... Without Adjustment
- ★ Ball Bearing Indexing, Precise Angle Setting, Powerful, Positive Baseline Clamp.

THE RIGHT DRAFTING MACHINE FOR EVERY DRAFTING NEED  
**UNIVERSAL DRAFTING MACHINE CORP.**  
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- ☐ Please send information on new 60 Tracmaster  
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Company .....

City..... Zone..... State.....



# KOH-I-NOOR

*Precision-Matched Instruments*

Koh-I-Noor offers draftsmen an important new dimension in a comprehensive line of instruments and accessories meticulously matched to provide new high levels of professional performance, efficiency and convenience.



**MODEL NO. 3060:** The regular Koh-I-Noor Rapidograph "Technical" Fountain Pen with self-contained automatic filling system, and pocket clip is a standard drafting room tool.

**MODEL NO. 3065:** A new model with 7 interchangeable drawing point sections, each color-coded to indicate a different line width. Best buy for the professional who requires frequent change of line widths. Each drawing point section complete with airtight refillable ink cartridge. Interchange is accomplished quickly, cleanly. Comes in handy desk top container.



## NOW... TWO KOH-I-NOOR RAPIDOGRAPH TECHNICAL FOUNTAIN PENS

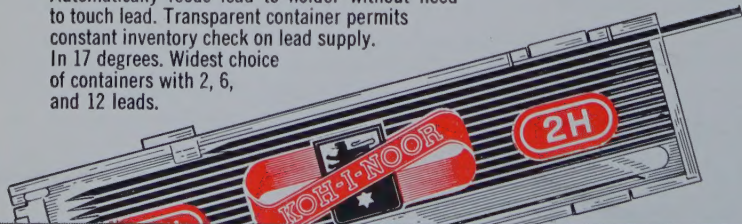
In 7 "color-coded" precision line widths: 00, 0, 1, 2, 2½, 3, 4. Uses India (or regular) ink for ruling, lettering, tracing or writing with equal facility.

(Write for catalog.)

Two Koh-I-Noor products designed to work together... for greater efficiency!

### KOH-I-NOOR EJECTOMATIC LEAD DISPENSER

Automatically feeds lead to holder without need to touch lead. Transparent container permits constant inventory check on lead supply. In 17 degrees. Widest choice of containers with 2, 6, and 12 leads.



### KOH-I-NOOR ADAPTO-CLUTCH LEAD HOLDERS

Widest choice of holders, all metal, perfectly balanced, with non-slip, turn-proof, replaceable clutch; knurled finger grip. With or without pocket clip, lead degree indicator, Color-Coded.

# KOH-I-NOOR PENCIL CO., Inc.

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